

What is claimed is:

1. A method of controlling a moving web in relation to a selected transverse position, the method comprising:

positioning a first positioning guide proximate a second positioning guide;

5 passing the web through the first positioning guide to reduce angular and transverse position errors;

passing the web through the second positioning guide wherein the second positioning guide positions the moving web with a mechanism having zero-backlash;

10 sensing a transverse location of the moving web at the second positioning guide with a sensor;

transmitting the transverse location of the web at the second positioning guide to a controller; and

15 manipulating a zero-backlash actuator with the controller wherein the zero-backlash actuator is coupled to the second positioning guide such that the transverse position of the web is controllable to within a preselected dimension of the selected transverse position.

2. The method of claim 1 wherein the preselected dimension of the selected transverse position is less than about 0.004 inches.

20 3. The method of claim 1 wherein the preselected dimension of the selected transverse position is between about 0.0001 inches and 0.004 inches.

25 4. The method of claim 1 wherein the preselected dimension of the selected transverse position is less than about 0.0001 inches.

5. The method of claim 1 wherein an exit span of the first positioning guide is less than about one-half a web width.

6. The method of claim 1 wherein the mechanism for moving the web having zero-backlash comprises a plurality of flexure plates.

7. The method of claim 6 wherein the method of adjusting the web with the second positioning guide comprises:

fixing a base in a desired position;

disposing a first base roller and a second base roller within the base wherein an axis of the first base roller and an axis of the second base roller are approximately parallel;

disposing at least one frame roller within a frame;

coupling the frame to the base with the plurality of flexure plates wherein the plurality of flexure plates are positioned such that the frame moves relative to the base at about a midpoint of an entrance tangent line of the web with the first frame roller;

disposing the web from the first base roller to the first frame roller in the frame;

disposing the web from the last frame roller to the second base roller;

sensing the transverse location of the web;

computing an error of the transverse location of the web relative to a set point;

relaying the error to the zero-backlash actuator; and

manipulating the actuator coupled to the frame such that the frame rotates at about the midpoint of an entrance tangent line of the web with the first frame roller such that the position of the web at about an exit tangent line on the last frame roller changes so as to reduce the error of the transverse location of the moving web.

8. The method of claim 7 wherein the transverse location of the web is sensed at about the exit tangent line of the moving web from the last frame roller.

9. The method of claim 7 and further comprising disposing first and second frame rollers within the frame wherein an axis of the first frame roller and an axis of the second frame roller are approximately parallel.
- 5 10. The method of claim 7 and further comprising coupling the actuator to the frame with a flexible plate.
11. The method of claim 1 wherein the sensor comprises at least a fifty hertz sensor with less than about twelve microns of resolution.
- 10 12. The method of claim 1 wherein the controller comprises a proportional-integral controller.
13. The method of claim 1 wherein the controller updates data from the sensor at a rate of at least about one hundred hertz.
- 15 14. The method of claim 1 wherein the zero-backlash actuator is capable of frequencies of greater than five hertz.
- 20 15. The method of claim 1 and further comprising controlling the first positioning guide with a feedback control system independent of the control system for the second positioning guide.
- 25 16. An assembly for controlling a transverse position of a moving web comprising:  
a first positioning guide having a first entrance span and a first exit span wherein the first positioning guide manipulates a transverse position of the moving web;  
a first closed loop control system cooperating with the first positioning guide wherein the first closed loop controller manipulates the first positioning guide to control the transverse position of the moving web;

a second positioning guide having a second entrance span and a second exit span  
wherein the second exit span is less than about one half a width of the web; and  
a second closed loop control system cooperating with the second positioning guide  
wherein the second closed loop controller manipulates the second positioning  
guide to control the position of the moving web to within less than 0.004  
inches of the setpoint.

17. The assembly of claim 16 wherein the first exit span is less than about one-half a width  
of the web.

18. The assembly of claim 16 wherein the second exit span is less than about one-quarter  
of a web width.

19. The assembly of claim 16 wherein the second exit span is less than about one-tenth of  
a web width.

20. The assembly of claim 16 wherein the second positioning guide comprises:  
a base fixed in a selected position wherein the base comprises a first base roller and a  
second base roller wherein an axis of the first base roller is approximately  
parallel to an axis of the second base roller;  
a frame comprising at least one roller; and  
a plurality of flexure plates coupling the frame to the base wherein the plurality of  
flexure plates are positioned such that the frame moves relative to the base at  
about a midpoint of an entrance tangent line of the web with the first frame  
roller.

21. The assembly of claim 20 wherein a path of the web at the second entrance span and  
the second exit span are substantially perpendicular to a plane of rotation of the frame.

22. The assembly of claim 20 wherein the frame further comprises a first frame roller and a second frame roller wherein an axis of the first frame roller is approximately parallel to an axis of the second frame roller.

5 23. The assembly of claim 20 and wherein the second closed loop control system comprises:

a web position detecting instrument;

a controller wherein the controller receives a signal from the web position detecting instrument and compares the signal to a setpoint; and

10 a positioning device attached to the frame and in communication with the controller wherein the positioning device provides a force to the frame which manipulates the position of the frame about the midpoint of an entrance tangent line of the web with the first frame roller.

15 24. The assembly of claim 23 wherein the web position detecting instrument detects the position of the web proximate an exit tangent line of the last frame roller.

25. The assembly of claim 23 wherein the positioning device comprises:

an actuator; and

20 a flexible bracket wherein the flexible bracket couples the actuator to the frame.

26. The assembly of claim 25 wherein the actuator is capable of control frequencies of greater than about five hertz.

25 27. The assembly of claim 23 wherein the controller comprises an update rate of more than about one hundred hertz.

28. The assembly of claim 23 wherein the controller comprises a proportional-integral controller.

29. The assembly of claim 23 wherein the web position detecting instrument comprises at least a fifty hertz sensor with at least about twelve microns of resolution.

30. A precision web guide comprising:

a base comprising a first base roller and a second base roller wherein an axis of the first base roller is substantially parallel to an axis of the second base roller;

a frame comprising at least one frame roller;

a plurality of flexure plates attaching the frame to the base wherein the plurality of flexure plates are positioned in selected positions such that the frame rotates about a midpoint of an entrance tangent line of the web with the first frame roller;

a sensor wherein the sensor determines a transverse position of the web;

a controller communicating with the sensor wherein the control determines the error of the transverse position of the web from a selected transverse position;

a positioning device communicating with the controller wherein the positioning device is mounted to the base; and

a flexible bracket coupling the frame and the positioning device wherein the positioning device provides a force to the frame through the flexure plate such that the frame rotates about a midpoint of an entrance tangent line of the web with the first frame roller, to adjust the transverse position of the web.

31. The web guide of claim 30 wherein the frame further comprises:

a first frame roller; and

a second frame roller wherein an axis of the first frame roller is substantially parallel to an axis of the second frame roller.

32. The web guide of claim 30 wherein the position device comprises a zero-backlash actuator.

33. The web guide of claim 32 wherein the zero-backlash actuator is capable of control frequencies of greater than about five hertz.

34. The web guide of claim 30 further including a last frame roller down web of the at least one frame roller, and wherein a distance between the second base roller and the frame roller is less than about one-half a web width.

35. The web guide of claim 30 further including a last frame roller down web of the at least one frame roller, and wherein a distance between the second base roller and the last frame roller is less than about one-tenth a web width.

36. The web guide of claim 30 wherein a path at an entrance span and an exit span are substantially perpendicular to a plane of rotation the frame.

37. The web guide of claim 30 wherein the controller comprises an update rate of at least about one hundred hertz.

38. The web guide of claim 30 wherein the controller comprises a proportional-integral controller.

39. The web guide of claim 30 wherein the sensor comprises at least a fifty-hertz sensor with up to about twelve microns of resolution.

40. The web guide of claim 34 wherein the sensor determines the transverse position of the moving web proximate the exit tangent line of the last frame roller.